Polarization by refraction

Task and equipment

Information for teachers

Additional Information

If light is incident upon a glass surface, then a part of that light will be refracted and the other part reflected. At the same time, it is polarized in such a way that the vector of the electrical field strength of the polarized reflected light oscillates at right angles to the incident plane, and that of the refracted light oscillates parallel to the incident plane. Polarization of the refracted light will be the greater, the less the angle of incidence deviates from 56° and the more glass plates it passes through.

Suggestions for Set-up and Performance

The main objective of this experiment is to investigate the extent of polarization of the refracted light.
The reason for investigating reflected light in one part of the experiment is that it is simpler to find the angle of maximum polarization for reflected light than for refracted light.
During the experiment the laboratory should be as dark as possible.

Remark

Under item 2. of the evaluation the students should have found the correlation between the intensity of the reflected light and the number of plates used on the basis of theoretical considerations. This correlation can be verified using the same experimental arrangement.

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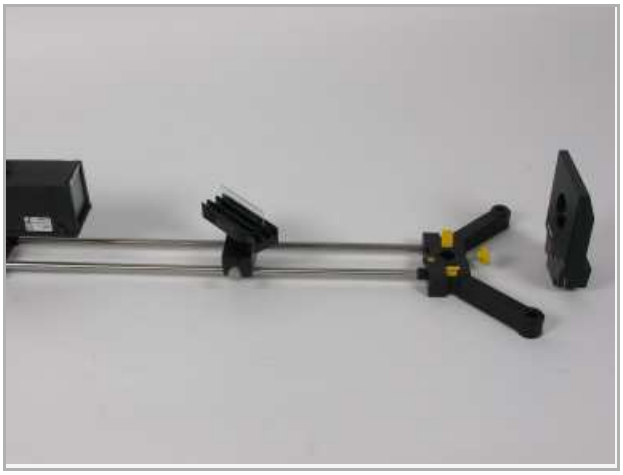
Task

Can light be polarized as a result of refraction?

Investigate whether light which has travelled through glass plates and thus undergone refraction, is polarized.
Secondly, find out whether there is a correlation between polarization and a) the angle of incidence and b) the number of glass plates used.



Student's Sheet

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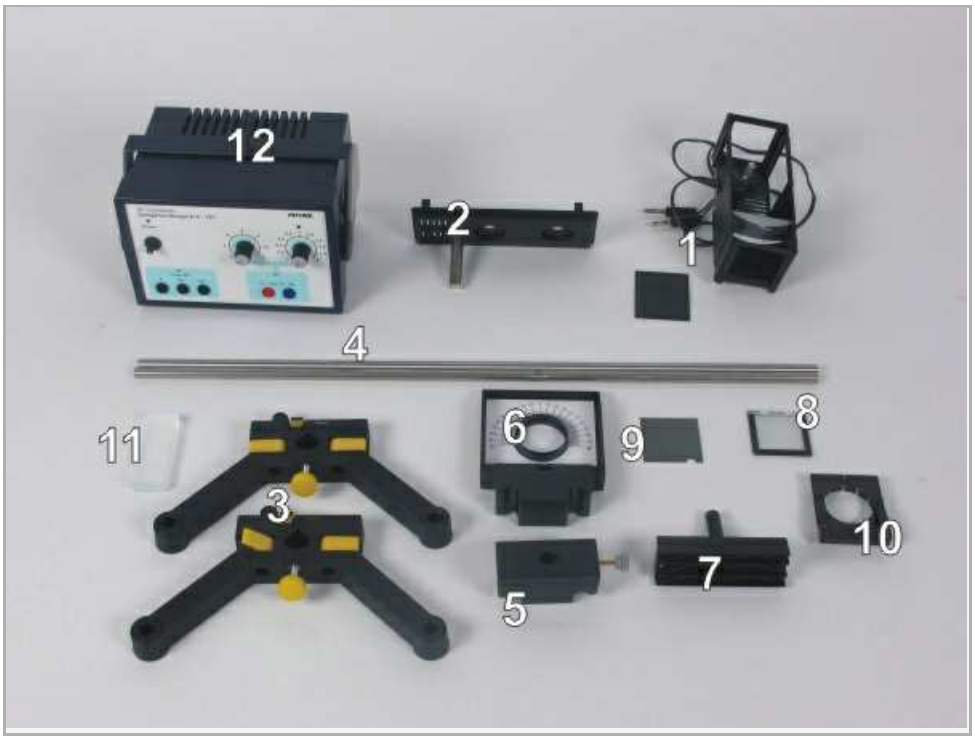
Equipment



Position No.	Material	Order No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Bottom with stem for light box	09802-10	1
3	Support base, variable	02001-00	1
4	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
5	Slide mount for optical bench	09822-00	1
6	Mount with scale on slide mount	09823-00	1
7	Plate mount f.3 objects	09830-00	1
8	Ground glass screen,50x50x2 mm	08136-01	1
9	Polarising filter, 50 mm x 50mm	08613-00	1
10	Diaphragm holder, attachable	11604-09	1
11	Microscopic slides, 50 pcs	64691-00	12 pcs
12	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Set-up and procedure

- Set up the optic bench with the two support rods and the support base (Fig. 1 and Fig. 2).

Fig. 1

Fig. 2

- Assemble the light box according to Figures 3 and 4 and clamp it into the left part of the support base with the lens end pointing towards the optic bench (Fig. 5). Insert the ground glass screen into the well in front of the lens (Fig. 6).

Fig. 3

Fig. 4

Fig. 5

Fig. 6

- Position the plate mount on the slide mount approx. 15 cm away from the light on the optic bench; do not fasten the screw

on the plate mount rod (Fig. 7).

Fig. 7

- Insert one glass plate into the plate mount and position this at an angle of 45° to the optical axis (Fig. 8).

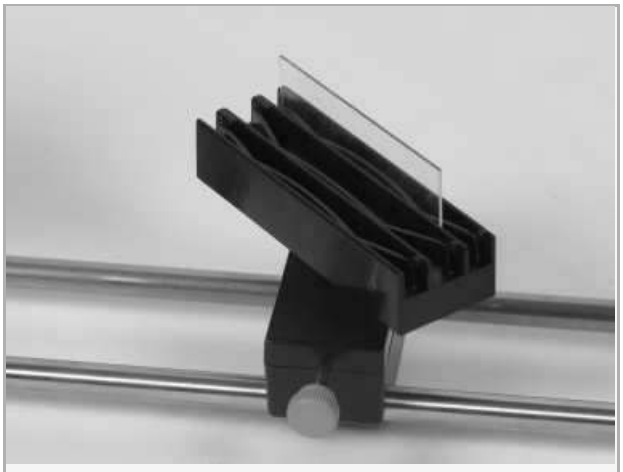


Fig. 8

- Insert the polarization filter into the diaphragm holder and attach this to the scale mount. Set up the scale mount to the right of the optic bench (Fig. 9).

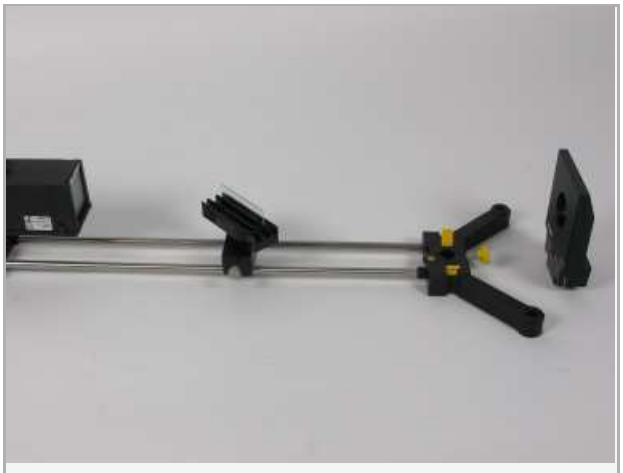


Fig. 9

- Connect the light to the power supply (12 V~) and swith on the power supply (Fig. 10).

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Fig. 10

- Look towards the refracted light through the polarization filter which from now on acts as analyzer; by turning the analyzer investigate whether the refracted light is polarized. Note your observations in the report (Result – Observations 1).
- Vary the angle of incidence of the light by turning the plate mount, and at the same time analyze the refracted light, noting your observation (Result – Observations 2). Make a note of the position of the analyzer in which the intensity of the emergent light is lowest.
- Again vary the angle of incidence by turning the plate mount, but this time analyze the reflected light. Find the angle at which polarization is most obvisous. Compare the position of the analyzer when the intensity of the visible light is lowest with the previous position noted above. Note your observations (Result – Observations 3).
- First, insert another 3 glass plates, then 4 more and again 4 more, into the plate mount and analyze the emergent refracted light without changing the angle of incidence. Note your observations (Result – Observations 4).
- Switch off the power supply.

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Report: Polarization by refraction

Result – Observations 1

Note down your observations during the rotation of analyzer:

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Result – Observations 2

Note down your observations during the variation of the angle:

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Result – Observations 3

Note down your observations during the third part of the experiment:

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Result – Observations 4

Note down your observations during the variation of the number of glass plates:

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Evaluation – Question 1

Summarize the results found in the experiment.

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Evaluation – Question 2

What explanation can you give for the fact that polarization of refracted light becomes stronger with increasing number of glass plates used? What correlation can be assumed to exist between the intensity of the reflected light and the number of glass plates used?

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